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Stephen R. Forrest

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EXAMINER

FICK, ANTHONY D

ART UNIT

PAPER NUMBER

1753

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/719,784

Applicant(s)

FORREST ET AL.

Examiner

Anthony Fick

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 April 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 18-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 18-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Remarks

1. Applicant's amendment to claim 25 has overcome the previous rejection under 35 U.S.C. 112 first paragraph. The rejection is therefore withdrawn.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 18, 19, 22-25, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al (WO 00/11725) in view of Sato et al (U.S. Patent 4,479,028) and Hanak (U.S. Patent 4,316,049).

As seen in Figure 8A, 8B, 8C, 8D, and 9 Forrest et al '725 teaches a stacked organic photosensitive optoelectronic device that comprises in order, an anode, a plurality of photosensitive optoelectronic subcells, and a cathode (see page 1, lines 12-15; page 7, line 33 through page 37, line 1). An example of a heterojunction for a subcell in the stacked device is CuPc/PTCDA or CuPc/PTCBI (see the paragraph bridging cols. 33 and 34). Other heterojunctions are shown on Table 1 at pages 44-45, and include heterojunctions that have C₆₀ buckminsterfullerene as an electron transport layer. Between each of the subcells is a semitransparent metallic layer of, for example, 10% Ag and 90% Mg, which has a thickness of 100 Angstroms or less, i.e., instant electron-hole recombination zone (see page 34, line 12 through page 35, line 26).

Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack" (see page 38, lines 22-27). Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device (see page 38, line 27 through page 39, line 1).

Alternatively, when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells (see page 39, lines 9-13). The adjustment of the thickness of the sublayers is to provide uniform current levels from each cell (see page 39, lines 12-13). In any event, said semitransparent metallic layer of, for example, 10% Ag and 90% Mg, which has a thickness of 100 Angstroms or less can also be present with an ITO layer as a composite charge transfer layer between the subcells in said Figure 8D. Forrest et al '725 teaches the limitations of the instant claims, other than the differences which are discussed below.

With respect to claims 18 and 25, and as noted above, Forrest et al '725 discloses a semitransparent metallic layer of, for example, 10% Ag and 90% M, which has a thickness of 100 Angstroms or less, whereas claim 18 calls for a thickness of less than about 20 Angstroms and claim 25 calls for a thickness of less than about 5 Angstroms. However, in the absence of anything unexpected, it would have been

obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's semitransparent metallic layer with a thickness of less than about 20 Angstrom or 5 Angstrom because Forrest et al '725 discloses a semitransparent metallic layer of, for example, 10% Ag and 90% M, which has a thickness of 100 Angstrom or less, which encompasses the instantly claimed ranges.

Forrest et al '725 does not specifically recite that the current generated by two of its subcells differs by less than 10%. However as noted above, Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack" (see page 38, lines 22-27). Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device (see page 38, line 27 through page 39, line 1). Alternatively, when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells (see page 39, lines 9-13). The adjustment of the thickness of the sublayers is to provide uniform current levels from each cell (see page 39, lines 12-13). Indeed, the adjustment of the thickness of subcell layers in multi-subcell solar cell devices so that each subcell produces equal current is a well known concept in the solar cell art. For example, Sato et al teaches that "[i]n the double-layer tandem device, the maximum output current is

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generated when the photovoltaic current of one of the two cells is equal to the photovoltaic current of the other cell, so it is very important to select suitable thicknesses of the cells" (see col. 4, lines 23-27). Likewise, Hanak et al, at col. 3, lines 21-31, notes the adjustment of thickness so that the current produced by solar layers (38) and (42) are the same (see the paragraph bridging paragraphs 2 and 3; and col. 3, lines 43-51). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's stacked organic photosensitive optoelectronic device such that the current generated in a first subcell of the stack is equal to or essentially equal to the current produced by a second subcell in the stack because Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack"; Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device; alternatively, Forrest et al '725 teaches that when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells; Forrest et al '725 teaches that the adjustment of the thickness of the sublayers is to provide uniform current levels from each cell; and, furthermore, as shown by Sato et al and Hanak, the adjustment of the thickness of subcell layers in multi-subcell solar cell

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devices so that each subcell produces equal current is a well known concept in the solar cell art.

4. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al '725 in view of Sato et al and Hanak as applied to claims 18, 19, 22-25, and 29 above, and further in view of Peumans et al, "Efficient photon harvesting at high optical intensities in ultrathin organic double-heterostructure photovoltaic devices," Applied Physics Letters, vol. 76(19), pages 2650-2652, May 8, 2000.

Forrest et al '725 in view of Sato et al and Hanak, as relied upon for the reasons recited above, teaches the limitations of the instant claims 20 and 21, the difference being that Forrest et al '725 does not teach the presence of an exciton blocking layer in its stacked organic photosensitive optoelectronic device. Peumans et al teaches that inserting an exciton blocking layer (EBL), such as BCP, between the photoactive region and the metal cathode of an organic photovoltaic device provides the advantages of increasing the efficiency, preventing damage due to cathode evaporation, eliminating parasitic exciton quenching at the electron-acceptor/cathode interface, and increasing the light absorption efficiency (see abstract; and the third paragraph on page 2650). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included an EBL between the photoactive region and a metal cathode of Forrest et al '725's stacked organic photosensitive optoelectronic devices because the inclusion of the EBL would provide the advantages of increasing the efficiency, preventing damage due to cathode evaporation, eliminating parasitic exciton quenching

at the electron-acceptor/cathode interface, and increasing the light absorption efficiency, as taught by Peumans et al.

5. Claims 27 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al '725 in view of Sato et al and Hanak as applied to claims 18, 19, 22-25, and 29 above, and further in view of Pettersson et al, "Modeling photocurrent action spectra of photovoltaic devices based on organic thin films," Journal of Applied Physics, vol. 86, no. 1. pages 487-496, July 1, 1999.

Forrest et al '725 in view of Sato et al and Hanak, as relied upon for the reasons recited above, teaches the limitations of instant claims 27 and 28, the difference being that Forrest et al '725 does not specifically teach presence of an anode-smoothing layer such as PEDOT in its stacked organic photosensitive optoelectronic device. Pettersson et al teaches an organic thin film photovoltaic device comprising an ITO anode; a PEDOT-PSS layer which reads on the instant anode-smoothing layer; a PEOPT hole transport layer; a C₆₀ fullerene layer electron transport layer; and an aluminum cathode (see pages 487-488). The PEDOT-PSS layer is used because it provides for better injection/collection conditions resulting in improved current-voltage characteristics compared to ITO/PEOPT. (see page 488, first column). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a PEDOT-PSS layer in Forrest et al '725's device because the PEDOT-PSS layer provides for better injection/collection conditions resulting in improved current-voltage characteristics compared to ITO/PEOPT, as taught by Pettersson et al.

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6. Claims 18, 19, 22-26, 29, 30, 33, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al (WO 00/11725) in view of Sato et al (U.S. Patent 4,479,028), Hanak (U.S. Patent 4,316,049), and Lewis (U.S. Patent 4,771,321).

As seen in Figure 8A, 8B, 8C, 8D, and 9 Forrest et al '725 teaches a stacked organic photosensitive optoelectronic device that comprises in order, an anode, a plurality of photosensitive optoelectronic subcells, and a cathode (see page 1, lines 12-15; page 7, line 33 through page 37, line 1). An example of a heterojunction for a subcell in the stacked device is CuPc/PTCDA or CuPc/PTCBI (see the paragraph bridging cols. 33 and 34). Other heterojunctions are shown on Table 1 at pages 44-45, and include heterojunctions that have C₆₀ buckminsterfullerene as an electron transport layer. Between each of the subcells is a semitransparent metallic layer of, for example, 10% Ag and 90% Mg, which has a thickness of 100 Angstroms or less, i.e., instant electron-hole recombination zone (see page 34, line 12 through page 35, line 26). Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack" (see page 38, lines 22-27). Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device (see page 38, line 27 through page 39, line 1). Alternatively, when sufficient electromagnetic radiation incident on each face is able to

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traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells (see page 39, lines 9-13). The adjustment of the thickness of the sublayers is to provide uniform current levels from each cell (see page 39, lines 12-13). In any event, said semitransparent metallic layer of, for example, 10% Ag and 90% Mg, which has a thickness of 100 Angstroms or less can also be present with said ITO layer as a composite charge transfer layer between the subcells in said Figure 8D.

Forrest et al '725 does not specifically recite that the current generated by two of its subcells differs by less than 10%. However as noted above, Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack" (see page 38, lines 22-27). Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device (see page 38, line 27 through page 39, line 1). Alternatively, when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells (see page 39, lines 9-13). The adjustment of the thickness of the sublayers is to provide uniform current levels from each cell (see page 39, lines 12-13). Indeed, the adjustment of the thickness of subcell layers in multi-subcell solar cell devices so that each subcell

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produces equal current is a well known concept in the solar cell art. For example, Sato et al teaches that "[i]n the double-layer tandem device, the maximum output current is generated when the photovoltaic current of one of the two cells is equal to the photovoltaic current of the other cell, so it is very important to select suitable thicknesses of the cells" (see col. 4, lines 23-27). Likewise, Hanak et al, at col. 3, lines 21-31, notes the adjustment of thickness so that the current produced by solar layers (38) and (42) are the same (see the paragraph bridging paragraphs 2 and 3; and col. 3, lines 43-51). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's stacked organic photosensitive optoelectronic device such that the current generated in a first subcell of the stack is equal to or essentially equal to the current produced by a second subcell in the stack because Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack"; Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device; alternatively, Forrest et al '725 teaches that when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells; Forrest et al '725 teaches that the adjustment of the thickness of the sublayers is to provide

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uniform current levels from each cell; and, furthermore, as shown by Sato et al and Hanak, the adjustment of the thickness of subcell layers in multi-subcell solar cell devices so that each subcell produces equal current is a well known concept in the solar cell art.

With respect to claims 26, 30, 33, and 37, Forrest et al '725 does not specifically teach that its semitransparent metallic layer between subcells can be the instant nanoparticle layer. Lewis teaches between subcells of a stacked photovoltaic device there can be used a thin layer of ohmic conductive substance, such as aluminum, where said layer forms beads which serve as a shorting interconnect while passing a large fraction of the radiation to the lower subcells and permitting lattice-matching between the subcells to be preserved (see abstract; col. 3, line 15 through col. 4, line 23; claim 12 at col. 12; and Figure 1. The beads are nanoparticles in view of their dimensions (see claim 13 at col. 12). The method of forming Lewis' interconnect is simple, rugged, and reliable (see col. 4, lines 11-17). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Lewis' beaded interconnect layer for the metallic layer between subcells in Forrest et al '725's device because Lewis teaches that its beaded layer serves as a shorting interconnect while passing a large fraction of the radiation to the lower subcells and permitting lattice-matching between the subcells to be preserved, and the method for preparing the beaded layer is simple, rugged, and reliable.

7. Claims 20, 21, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al '725 in view of Sato et al, Hanak, and Lewis as applied

to claims 18, 19, 22-26, 29, 30, 33, and 37 above, and further in view of Peumans et al, "Efficient photon harvesting at high optical intensities in ultrathin organic double-heterostructure photovoltaic devices," Applied Physics Letters, vol. 76(19), pages 2650-2652, May 8, 2000.

Forrest et al '725 in view of Sato et al, Hanak, and Lewis, as relied upon for the reasons recited above, teaches the limitations of the instant claims 20, 21, 31, and 32, the difference being that Forrest et al '725 does not teach the presence of an exciton blocking layer in its stacked organic photosensitive optoelectronic device. Peumans et al teaches that inserting an exciton blocking layer (EBL), such as BCP, between the photoactive region and the metal cathode of an organic photovoltaic device provides the advantages of increasing the efficiency, preventing damage due to cathode evaporation, eliminating parasitic exciton quenching at the electron-acceptor/cathode interface, and increasing the light absorption efficiency (see abstract; and the third paragraph on page 2650). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included an EBL between the photoactive region and a metal cathode of Forrest et al '725's stacked organic photosensitive optoelectronic devices because the inclusion of the EBL would provide the advantages of increasing the efficiency, preventing damage due to cathode evaporation, eliminating parasitic exciton quenching at the electron-acceptor/cathode interface, and increasing the light absorption efficiency, as taught by Peumans et al.

8. Claims 27, 28, 35, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al '725 in view of Sato et al, Hanak, and Lewis as applied

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to claims 18, 19, 22-26, 29, 30, 33, and 37 above, and further in view of Pettersson et al, "Modeling photocurrent action spectra of photovoltaic devices based on organic thin films," Journal of Applied Physics, vol. 86, no. 1. pages 487-496, July 1, 1999.

Forrest et al '725 in view of Sato et al, Hanak, and Lewis as relied upon for the reasons recited above, teaches the limitations of instant claims 27, 28, 35, and 36, the difference being that Forrest et al '725 does not specifically teach presence of an anode-smoothing layer such as PEDOT in its stacked organic photosensitive optoelectronic device. Pettersson et al teaches an organic thin film photovoltaic device comprising an ITO anode; a PEDOT-PSS layer which reads on the instant anode-smoothing layer; a PEOPT hole transport layer; a C₆₀ fullerene layer electron transport layer; and an aluminum cathode (see pages 487-488). The PEDOT-PSS layer is used because it provides for better injection/collection conditions resulting in improved current-voltage characteristics compared to ITO/PEOPT. (see page 488, first column). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a PEDOT-PSS layer in Forrest et al '725's device because the PEDOT-PSS layer provides for better injection/collection conditions resulting in improved current-voltage characteristics compared to ITO/PEOPT, as taught by Pettersson et al.

9. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al '725 in view of Sato et al, Hanak, and Lewis as applied to claims 18, 19, 22-26, 29, 30, 33, and 37 above, and further in view of Aratani et al (U.S. Patent 5,854,139).

Forrest et al '725 in view of Sato et al, Hanak, and Lewis are relied upon for the reasons recited above. Forrest et al '725 in view of Sato et al, Hanak, and Lewis teach the limitations of claim 34, the difference being that Lewis does not specifically teach that its layer of high ohmic conductance material can be made from silver, as in instant claim 34. Lewis does teach that its layer of high ohmic conductance material can be made from a material such as indium, gallium, aluminum, etc (see col. 3, lines 36-37). Aratani et al teaches what is very well known, i.e., materials such as indium, aluminum, copper, etc, are interchangeably used for ohmic contact materials (see the paragraph bridging cols. 8 and 9). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used copper in place of indium or aluminum for Lewis' high ohmic conductance material because the substitution of art recognized equivalents, as shown by Aratani et al, would have been within the level of ordinary skill in the art.

Double Patenting

10. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to

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be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

11. Claims 18 through 37 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-26 of U.S. Patent No. 6,198,091 in view of Forrest et al. (WO 00/11725). Although the conflicting claims are not identical, they are not patentably distinct from each other because note that claim 6 of said patent teaches that each of the subcells is selected so that each of the subassemblies will generate substantially the same voltage when the device is exposed to ambient electromagnetic radiation and the selection of electron-hole recombination zone less than 20 angstroms in thickness is obvious in view of Forrest as stated in the rejections above.

12. Claims 18-37 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-27 of U.S. Patent No. 6,198,092 in view of Forrest et al. (WO 00/11725). Although the conflicting claims are not identical, they are not patentably distinct from each other because note that claim 3 of said patent teaches that each of the organic photosensitive optoelectronic subcells is selected to maximize the total current output of the device and the selection of electron-hole recombination zone less than 20 angstroms in thickness is obvious in view of Forrest as stated in the rejections above. Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have selected each of the subcells to have an equal or approximately equal current output so as to

maximize total current output and to utilize the cell interconnection of Forrest including the electron-hole recombination zone of less than 20 angstroms thick.

13. Claims 18-37 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-31 of copending Application No. 10/822,774 in view of Forrest et al. (WO 00/11725).

Although the conflicting claims are not identical, they are not patentably distinct from each other because note in claim 30 of said copending application that the first organic layer (i.e., first subcell) and second organic layer (i.e., second subcell) can contribute the same amount of photocurrent to the device and the selection of electron-hole recombination zone less than 20 angstroms in thickness is obvious in view of Forrest as stated in the rejections above.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

14. Claims 18-37 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-29 and 32-36 of copending Application No. 10/910,371 in view of Forrest et al. (WO 00/11725).

Although the conflicting claims are not identical, they are not patentably distinct from each other because note in claim 7 of said copending application that the first organic layer (i.e., first subcell) and second organic layer (i.e., second subcell) can contribute the same amount of photocurrent to the device and the selection of electron-hole recombination zone less than 20 angstroms in thickness is obvious in view of Forrest as stated in the rejections above.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

15. Applicant's arguments filed April 30, 2007 have been fully considered but they are not persuasive.

Applicant argues that Forrest et al '725 does not disclose an electron-hole recombination zone. Applicant argues that the thin semitransparent metallic layers of Forrest et al are part of a compound cathode, rather than an electron-hole recombination zone. However, this argument is not deemed to be persuasive because Forrest et al's solar cell has essentially the same structure as in the instant solar cell, e.g., plural CuPc/PTCDA subcells with a semitransparent metallic layer of thickness 100 Angstrom or less containing silver between each of the subcells (see page 34, line 4 through page 35, line 26 of Forrest et al '725; and page 7, lines 9-13 of the instant specification). Forrest et al '725's semitransparent metallic layer of thickness 100 Angstrom or less is, for example, 10% Ag and 90% Mg (see page 35, lines 23-35). The instant semitransparent semimetal layer that functions as an electron-hole recombination zone is made from, for example, silver, and has a thickness such that it is thin enough to be semitransparent in order to allow light to reach the back cells (see page 14, lines 24-26, of the instant specification). The point the Examiner is making here is that Forrest et al '725 is using essentially same materials to prepare is semitransparent metallic layer as the instant semitransparent layer, Forrest et al '725's semitransparent layer and the instant semitransparent layer have essentially the same

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thickness, and the layer is located in essentially the same location in the device as the instant layer. Accordingly, it is the Examiner's position that Forrest et al's semitransparent metallic layer provides the claimed property of being an electron-hole recombination zone. This is particularly so in Forrest et al '725's Figure 8D (see also page 36, lines 3-8 of Forrest et al '725). Forrest et al '725's semitransparent metallic layer will provide whatever properties are associated with it. Just because Applicant has found a new property of Forrest et al '725's semitransparent metallic layer in Forrest et al '725's device does not make essentially the same device patentable. Furthermore, as seen in the instant specification, a layer of silver (semitransparent metal layer) between the subcells can be considered to be the instant electron hole recombination zone, while another layer of silver on the top of the device can be the electrode (see page 21, lines 26-28). No good reason has been provided as to why Forrest et al '725's semitransparent metal layer containing silver and between the subcells would not provide the property of electron-hole recombination.

Applicant argues that the instant electron-hole recombination zone has a thickness that is less than about 20 angstroms. As stated above, Forrest et al '725 discloses a semitransparent metallic layer of, for example, 10% Ag and 90% M, which has a thickness of 100 Angstroms or less, whereas claim 18 calls for a thickness of less than about 20 Angstroms. However, in the absence of anything unexpected, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's semitransparent metallic layer with a thickness of less than about 20 Angstrom because Forrest et al '725 discloses a semitransparent

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metallic layer of, for example, 10% Ag and 90% M, which has a thickness of 100 Angstrom or less, which encompasses the instantly claimed range.

Applicant argues that Sato et al, Hanak et al, Peumans et al, Pettersson et al, Aratani et al, and Lewis "do not cure the deficiencies of Forrest et al ['725]." However, as noted above, Forrest et al '725 is not deficient.

Applicant argues that there is no motivation to combine references. However, this argument is not deemed to be persuasive because the motivation to combine references is clearly set forth above. For example, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's stacked organic photosensitive optoelectronic device such that the current generated in a first subcell of the stack is equal to or essentially equal to the current produced by a second subcell in the stack because Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative position of a subcell in the stack"; Forrest et al '725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device; alternatively, Forrest et al '725 teaches that when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells; Forrest et al '725 teaches that the adjustment of the thickness of

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the sublayers is to provide uniform current levels from each cell; and, furthermore, as shown by Sato et al and Hanak, the adjustment of the thickness of subcell layers in multi-subcell solar cell devices so that each subcell produces equal current is a well known concept in the solar cell art. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included an EBL between the photoactive region and a metal cathode of Forrest et al '725's stacked organic photosensitive optoelectronic devices because the inclusion of the EBL would provide the advantages of increasing the efficiency, preventing damage due to cathode evaporation, eliminating parasitic exciton quenching at the electron-acceptor/cathode interface, and increasing the light absorption efficiency, as taught by Peumans et al. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a PEDOT-PSS layer in Forrest et al '725's device because the PEDOT-PSS layer provides for better injection/collection conditions resulting in improved current-voltage characteristics compared to ITO/PEOPT, as taught by Pettersson et al. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Forrest et al '725's stacked organic photosensitive optoelectronic device such that the current generated in a first subcell of the stack is equal to or essentially equal to the current produced by a second subcell in the stack because Forrest et al '725 teaches that a stacked device which is connected in series as in embodiment 8D00 in Figure 8D, "fundamental current continuity" considerations constrain the device's current output so that it is limited to the current which goes through the subcell generating the least current regardless of the relative

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position of a subcell in the stack”; Forrest et al ‘725 addresses this problem by varying the thickness of the photoconductive organic layers, e.g., such that each subcell has exponentially thicker photoconductive organic layers if measured starting at the top of the device; alternatively, Forrest et al ‘725 teaches that when sufficient electromagnetic radiation incident on each face is able to traverse the device, then the layers in the subcells in the center of the device are made thicker than the layers in subcells; Forrest et al ‘725 teaches that the adjustment of the thickness of the sublayers is to provide uniform current levels from each cell; and, furthermore, as shown by Sato et al and Hanak, the adjustment of the thickness of subcell layers in multi-subcell solar cell devices so that each subcell produces equal current is a well known concept in the solar cell art.

Applicant argues that each subcell of the stacked devices of claims 1-26 of U.S. Patent 6,198,091 (the ‘091 patent) and claims 1-27 of U.S. Patent 6,198,092 (the ‘092 patent) has a cathode and an anode, and thus, can not be separated by an electron-hole recombination zone. However, this argument is not deemed to be persuasive because the claims in the ‘091 and ‘092 patents encompass what is seen in Figure 8D in the ‘091 and ‘092 patents, where a photo-induced current traverses the device. This Figure 8D is essentially the same as discussed above with respect to Figure 8D in Forrest et al ‘725.

With respect to 10/822,744 (the ‘744 application), Applicant argues that the first organic layer of claims 1-31 of the ‘744 application is a single layer and is a mixture of an organic acceptor and an organic donor material, and that “[t]his is distinct from the

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subcells of the present claims which comprise two layers -- an electron donor layer and an electron acceptor layer." Applicant also argues that the second organic layer of claims 1-31 of the '744 application is also a single layer and "distinct from the subcells of the present claims which comprise an electron donor and an electron acceptor."

Similar arguments are provided with respect to claims 1-32 of 10/910,371 (the '371 application). However, these arguments are not deemed to be persuasive because the language "comprising an electron donor layer and an electron acceptor layer" in the instant claims is so broad that it encompasses the situation in the claims of the '744 and the '371 applications where the electron donor and electron acceptor are in the same "layer", and the situation in the claims of the '371 application where there is a further unmixed layer acceptor or donor material.

Conclusion

16. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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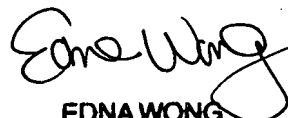
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anthony Fick whose telephone number is (571) 272-6393. The examiner can normally be reached on Monday - Friday 7 AM to 4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Anthony Fick
AU 1753
July 18, 2007

ADF


EDNA WONG
PRIMARY EXAMINER

7/19/07